A

CATECHISM

OF

CHEMISTRY;

INTENDED TO

Assist the Learner in attaining a Knowledge

OF THE

SECRETS OF NATURE;

By unfolding to his View, the

VARIOUS SUBSTANCES

DISCOVERED BY PROFESSORS,

And the Processes they undergo to render them beneficial to Mankind.

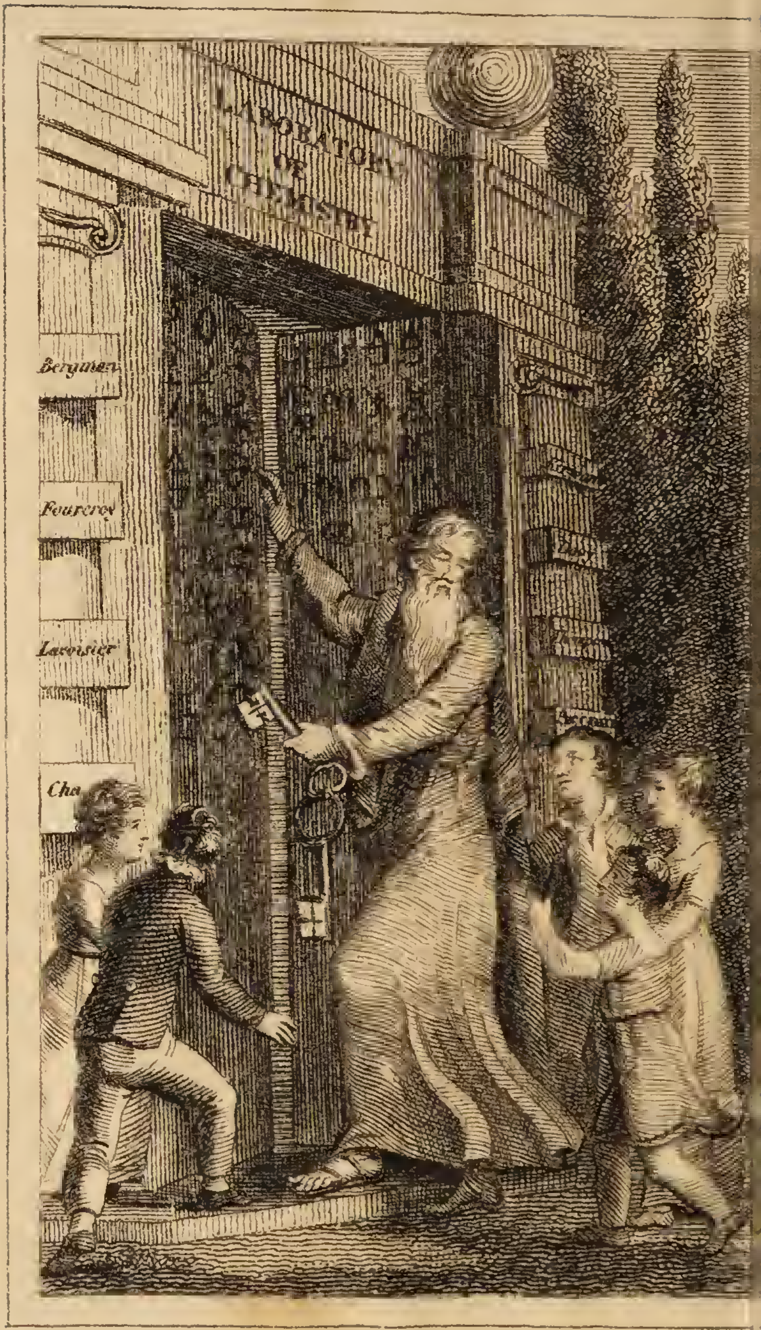
By G. ROBERTS,

Master of Rodden Classical and Commercial Seminary, near Frome.

Price Nine-pence.

Bridge House
Dorchester
Oxon

CHEMISTRY.



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CATECHISM

OF

CHEMISTRY.

CHAPTER I.

Of the general Principles of Chemistry.

Question. WHAT is Chemistry?

Answer. That science which *investigates* the properties and mutual action of the *elementary* parts of bodies.

Q. Are not fire, air, and water, the elementary parts of bodies?

A. By no means: modern chemists have discovered that these may be decomposed, and consequently that they are compounds and not simple bodies.

Q. What do you mean by decomposing a body?

In-ves'-ti-gate, *v.* to search out; to trace or find out by reason.

E-le-men-ta-ry, *a.* simple, having only one principle for its essence.

A. Separating its component parts; it differs from division, as that is merely a separating of the compound into smaller parts of the same nature; but the parts into which a body is decomposed are the simple elements of which it was originally formed.

Q. How many simple elements are there?

A. About forty; they are divided and classed as follow:

CLASS I.

Comprehending the imponderable agents, or those that have no weight.

Heat, or Caloric---Light---Electricity.

CLASS II.

Oxygen.

CLASS III.

Comprehending bodies capable of uniting with oxygen, and forming with it various compounds.

DIVISION I.

Hydrogen---forming Water.

DIVISION II.

Bodies forming Acids.

Nitrogen-- forming Nitric acid.

Carbon--------------Carbonic acid.

Sulphur-------------Sulphuric acid.

Phosphorus forming Phosphoric acid.
Boracium-----------Boracic acid.
Fluorium-----------Fluoric acid.
Muriatium----------Muriatic acid.

DIVISION III.

Metallic bodies forming alkalies.

Potassium, forming potash-----Sodium, forming soda----Ammonium, forming ammonia.

DIVISION IV.

Metallic bodies forming earth.

Calcium, or metal forming lime.
Magnium------------------magnesia.
Strontium------------------strontites.
Jargonium------------------jargonia.
Silicium--------------------silex.
Alumium-------------------alumine.
Yttrium--------------------yttria.
Glucium-------------------glucina.
Zirconium------------------zirconia.

DIVSION V.

Metals, either naturally metallic, or yielding their oxygen to heat alone.

SUBDIVISION I.

Malleable metals.

Gold,	Mercury,*	Lead.
Platina,	Tin,	Nickel.
Palladium,	Copper,	Zinc.
Silver,	Iron.	

SUBDIVISION II.

Brittle metals.

Arsenic,	Cobalt,	Uranium.
Bismuth,	Tungsten,	Columbium or Tantalium.
Antimony,	Molesbdinum,	Iridium.
Manganesa,	Titanium,	Osmium.
Tellarium,	Chrome,	Rhodium.

Q. How do these simple bodies form compounds?

A. By means of a force called chemical attraction, or attraction of composition.

Q. How are compound bodies decomposed?

A. By the same principle.

Q. How is it possible that composition and decomposition can be effected by the same means?

* Mercury can be considered as malleable only, when by excessive cold, it is fixed, and its fluidity destroyed.

A. Bodies may have different degrees of attraction for each other. Suppose I pour some nitric acid or copper filings, for which it has a strong attraction, every particle of the copper will combine with a particle of the acid, and form a new body totally different from either: but if I wish to decompose this, I throw in some iron filings, and as these have a stronger attraction for the acid, it leaves the copper to unite with the iron, and the copper is precipitated in its former state.

Q. What is the cause of chemical attraction or affinity?

A. It is not certainly known, but supposed to arise from positive and negative electricity, as they attract each other.

CHAP. II.

Of Caloric.

Q. What is Caloric?

A. The matter of light and heat. It may be considered under two heads.----Free or

radiant caloric, and combined caloric.--The first or free or radiant caloric is also called heat or temperature, it means such heat as is sensible and affects the thermometer.

Q. What are the properties of free caloric?

A. It has the power of *dilating* bodies; for it is so extremely subtle, that it pervades all substances, and by forcing itself between their particles, causes them to occupy a greater space than before. When this is carried to a considerable degree in some bodies, it completely separates those particles, and they are fused or melted.

Q. What is the consequence of uniting caloric with a fluid?

A. It forms itself in such abundance between its particles, as completely to destroy their attraction of cohesion, and they fly off in the form of vapour.

Q. By what means can you prove that caloric expands bodies?

A. Take a round piece of iron, and a ring that slides on it and fits it exactly, heat

Di-late, *v.* to extend, to spread out, to enlarge.

the iron red hot, and the ring will not then be large enough to admit it.

Q. What is the next property of free caloric?

A. It always tends to diffuse itself equally, so that when two bodies are of unequal temperatures, the warmer gradually parts with its heat to the colder, till they arrive at an equilibrium. Thus when a thermometer is applied to a hot body, it receives caloric; when to a cold one, it imparts it, till they both arrive at an equal temperature.

Q. Is cold then a substance or a negative quality?

A. Cold is merely a negative quality, simply implying the absence of heat.

CHAP. III.

Of combined Caloric, or specific and latent Heat.

Q. What is combined Caloric?

A. Bodies containing considerable quantities of caloric, which is, as it were, im-

prisoned in them, and does not communicate the sensation of heat as free caloric does: this is called combined caloric, as being composed of specific and latent.

Q. What is specific caloric?

A. It has been ascertained by modern chemists, that different bodies do not contain an equal quality of caloric, when heated to the same temperature. Thus for instance, if you place a pound of lead, a pound of chalk, and a pound of milk in a hot oven, they will be gradually heated to the temperature of the oven; but the lead will acquire this temperature first, as having the greatest capacity for caloric, the chalk next, and the milk last. Specific caloric therefore means the relative quantities of caloric that different bodies can contain.

Q. How can you ascertain that a less quantity of caloric enters into the lead than into other bodies, to raise it to the same temperature?

A According to our former theory, that caloric has a tendency to an equilibrium.

Place these three bodies in equal quantities of water of the same degree of coldness, you will find that the water in which the lead has been immersed will be the least heated, that of the chalk next, and the milk most of all.

Q. May not this proceed from the chalk and milk, though of the same weight, possessing greater quantities of matter than the lead?

A. Equal weight must always contain equal quantities of matter, though their *dimensions* may be different: therefore when we want to know the relative capacities of different bodies for caloric, we must compare equal weights, and not equal bulks.

Q. What is latent caloric?

A. It is that portion of insensible caloric which is employed in changing the state of bodies; that is in converting solids into liquids, and liquids into vapour. When a body changes from solid to liquid, or from liquid to vapour, its *expansion* occasions a

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Di-men-si-on, *s.* the size of a body.

Ex-pan-si-on, *s.* the art of stretching out a body by which its dimension is increased.

sudden increase of capacity for heat, and it immediately *absorbs* a quantity of calocic, which becomes fixed in the body which it has transformed ; and as it is perfectly concealed from our senses it is called *latent* heat.

Q. What experiments prove this ?

A. Snow may be cooled by chemical means, many degrees below the freezing point. If this be exposed to a moderate heat, the thermometer immersed in it will gradually rise till all the ice is melted.--- The reason is, that the new-formed liquid absorbs the caloric without its temperature being raised ; but when all the ice is dissolved, the thermometer again begins to rise.

Q. As solids converted to fluids absorb latent heat, do fluids converted to solids give forth their caloric ?

A. If you take muriat of lime dissolved in water, and pour into the mixture a few drops of sulphuric acid, nearly the whole will be changed into a solid mass, and it

---

Ab-sorb, *v.* to suck up.

will give out its latent heat so as to be sensibly felt.

If you take a solution of sulphat of soda, made very strong, and corked in a bottle while hot, it will not crystallize; but when it is cold, if you uncork the bottle, on the admission of the air, the salt will suddenly crystallize, and give out its latent heat, so that the bottle will be warm.

The heat that is felt on adding water to quick lime, proceeds from the water on its being converted into a solid.

CHAP. IV.

Of Atmospherical Air.

Q. Of what is Atmospherical Air composed?

A. Of two gasses, called oxygen and nitrogen gas.

Q. What is gas?

A. Any flucid capable of existing in an *æriform* state, under the pressure, and at the temperature of the atmosphere.

Q. Is not water or any other fluid, when *evaporated* by heat, called a gas?

A. No; vapour is indeed, an elastic fluid, resembling a gas; but it owes its elasticity to a temperature equal to that of boiling water, and on cooling, instantly returns to its original form; but gas has never yet been rendered liquid or solid by any degree of cold.

Q. In what proportions do oxygen and nitrogen exist in the atmosphere?

A. Oxygen gas constitutes rather more than one fifth, and nitrogen gas rather less than four-fifths of the whole.

Q. Do they resemble each other in their qualities?

A. They are totally different. Oxygen gas may be respired, and likewise greatly assists combustion, while nitrogen gas totally destroys both.

Q. How then can we breathe the atmosphere freely?

A. Were it composed of oxygen alone,

E-va-po-rate, *v.* to dissipate moistures into fume, steam, and vapour.

we should respire too freely, it is only by the proportion above mentioned that it exactly answers its intended purpose.

Q. How may these gasses be separated?

A. Many ways: first by combustion. If you place a lighted taper under a receiver that excludes the external atmosphere, it will burn a short time and gradually expire. On examining the contents of the receiver, you will find it to be nitrogen gas, the oxygen having been absorded by the combustion.

Second: metals have a great affinity for oxygen, that at some temperature absorb, while at others they give it forth; put some oxyd of manganese into a retort, place the retort in a furnace and make it red hot, connect the nect of the retort with a bent tube, the extremity of which is immersed in a vessel of water, the oxygen will rise through the water in the form of bubbles, and may be received in a vessel for the purpose, and preserved for experiments as long as may be necessary.

Q. By what experiment do you prove that

oxygen is essential to and accelerates combustion?

A. Iron itself may be burnt in pure oxygen gas; take a vessel filled with it, introduce a spiral iron wire into the vessel through the cork, with a bit of lighted tinder attached to it, it will burn with a beautiful bright flame, till either the iron or the oxygen is totally expended.

Q. What becomes of the oxygen during the combustion?

A. It unites with the drops of melted iron that fall to the bottom of the vessel, and which are now become an oxyd of iron; this may be proved by their being found heavier than the wire before it was burnt.

Q. Is there any other method of separating oxygen and nitrogen gas?

A. Yes, a very simple one: breathe through a tube into a receiver till you feel yourself exhausted, the air in the receiver will then be nitrogen gas, in which a taper will not burn.

CHAP. V.

Of Hydrogen.

Q. WHAT is Hydrogen?

A. It was formerly called inflammable air, as it is extremely combustible; it is now denominated hydrogen, which signifies *to produce water.*

Q. How does hydrogen produce water?

A. By combustion. Water is composed of eighty-five parts of oxygen, combined with fifteen parts of hydrogen. If we take a vessel wiih the water to be decomposed, and pour into it some sulphuric acid and iron filings, the bubbles that arise are hydrogen gas; if these are made to pass through a small tube inserted into the vessel through the cork, and the flame of a candle applied to them, they will burn with a vivid flame. If a receiver be placed over this flame, its interior will be covered with drops of water arising from the combustion of the hydrogen gas.

Q. Has this process ever been attempted on a large scale?

A. M. Lavoisier invented a very perfect and ingenious apparatus for the formation of water, by the combination of oxygen and hydrogen gasses. Two tubes, the one conveying the requisite proportion of oxygen, the other of hydrogen gas, are inserted at opposite sides of a large glass globe previously exhausted of air; the two streams of gas are kindled by the electric spark, at the point when they come in contact; the hydrogen combines with the oxygen, the caloric is set at liberty, and a quantity of water is produced exactly equal in weight to that of the two gasses introduced into the globe. Nearly a pound of water has been produced in this way, but it is a tedious process.

Q. Is there not another curious effect arising from the combustion of hydrogen gas?

A. If, instead of a receiver, we place over the flame a glass tube about two feet long, and an inch in diameter, open at both ends, a strong and rather a pleasing sound will be emitted, not much unlike that produced by the Eolian harp.

Q. What other properties has hydrogen gas?

A. It is specifically lighter than common air, and is therefore made use of for filling balloons. It likewise is extremely combustible, for if a quantity be confined in a phial, and fired by means of the electric spark, it *detonates* with a considerable report, and either forces out the cork or bursts the phial.

Q. Is hydrogen found in any considerable quantities?

A. Nature abounds with hydrogen; it constitutes a considerable portion of the water belonging to our globe. It enters into the composition of all animal substances, and of many minerals; but it abounds in vegetables. From its great levity, it rises into the superior regions of the atmosphere, and when ignited by a casual electric spark, or by any other means, it perhaps produces those meteors or luminous appearances we occasionally see.

De-to-nate, *v.* to make a loud noise resembling the explosion of gunpowder.

CHAP. VI.

Of Sulphur and Phosphorus.

Q. What is Sulphur?

A. It is a very combustible substance, that exists in a solid form at the temperature of our atmosphere. It is seldom found in a pure unmixed state, for its affinity to other substances is so great, that it is generally found mixed with some of them; it is found in a greater or less quantity in the mineral, vegetable, and animal kingdom.

Q. What are flowers of sulphur?

A. Merely common sulphur reduced to a very fine powder by *sublimation*.

Q. How is that performed?

A. Some lumps of sulphur are put into a cucurbit, which when covered with its head, is placed over a sand bath that is kept heated by a furnace. The sulphur soon begins to melt, a thick white smoke arises, which gradually condenses against the sides of the head, something like vegetation, from whence it has obtained its name.

Sub-li-ma-ti-on, *s.* the act of condensing or collecting nito a solid form.

Q. What advantages arise from this process?

A. It divides the sulphur into minute parts, and purifies it from those heterogeneous substances with which it is combined.

Q. What effect does the combustion of sulphur produce?

A. It produces when combined wit water, sulphurous acid. Let it be remembered that the weaker acids are distinguished by the termination *ous*, the stronger by the termination *ic*; thus sulphurous acid is the weaker, sulphuric acid the stronger of the two.

Q. How is the sulphuric acid produced?

A. By burning sulphur in pure oxygen gas, and thus rendering its combustion more complete.

Q. Does not sulphur readily combine with hydrogen?

A. Yes; and the combination is called sulphurated hydrogen gas. Of this nature are the Harrowgate waters, which can be exactly imitated by impregnating common water with this gas.

CHAP. VII.

Of Phosphorus.

Q. What is Phosphorus?

A. It has generally been considered as one of the simple bodies, though existing in nature closely combined with other substances, and never found in its pure separate state.

Q. What are the properties of Phosphorus?

A. It is eminently combustible; it melts and takes fire at the temperature of one hundred degrees of Fahrenheit's thermometer, and absorbs in its combustion, half as much again of oxygen as its own weight.

Q. How is this proved?

A. If I put a little bit of phosphorus into a receiver filled with oxygen gas, and fire it by means of a hot wire, it will burn with such a vived blaze, that the eye can scarcely endure its brightness. It is easy to ascertain the quantity of oxygen consumed. In the combustion of a pound of phosphorus, sufficient caloric has been disengaged to melt one hundred pounds of ice, as proved by the calorimeter.

Q. What is the calorimeter?

A. It is a vessel, the inner surface of which is lined with ice, so as to form a sort of hollow globe of ice, in the midst of which the body whose specific heat is to be ascertained, is placed. The ice absorbs caloric from the body until it has brought it down to the freezing point. The quantity of ice changed to water, which runs off through an apertune in the bottom, is a test of the quantity of caloric that the body to be examined, has given out.

Q. Is the result of this combustion an acid?

A. Yes, phosphoric acid; and if we duly proportion the phosphorus and acid, the result will be phosphoric acid of exactly the weight of those two substances previous to combustion.

Q. What is the method of producing phosphororus acid?

A. By simply exposing phosphorus to the atmosphere, it undergoes a slow combustion; a whitish vapour arises from this,

which united with water, produces phosphorous acid.

Q. Is phosphorus of any other service?

A. It serves to ascertain the purity or impurity of atmospheric air, for this purpose it is burnt in a graduated tube called an *endiometer*, which shewing how much oxygen is absorbed by the combustion, shews what proportion of it there is in the air examined; what remains is nitrogen. When combined with sulphur it forms a compound so extremely combustible, that matches dipped in it, immediately take fire on coming in contract with the air. In very cold weather they require to be rubbed to raise their temperature.

Q. Will prosphorus combine with hydrogen gas?

A. Yes: and the phosphorated hydrogen gas has this remarkable peculiarity, that it takes fire spontaneously at any temperature of the atmosphere. From this union probably proceed those delusive fires called ignis fatui.

Q. Are there any other combinations of phosphorous?

A. Yes: it is frequently united with lime, and the combination is called phosphurel of lime, as the union of sulphur with lime, is called sulphurel of lime. It has the singular property of decomposing water by being simply thrown into it.

Q. How does it effect this?

A. By absorbing the oxygen of water, in consequence of which bubbles of hydrogen gas ascend, holding a small quantity of phosphorus in solution; this is called phosphorated hydrogen gas, it takes fire and detonates on coming in *contact* with the atmosphere.

Q. Is there any other curious experiment to be made with phosphorus?

A. Put a little solution of potash into a retort with a small piece of phosphorus, place its neck in water and heat it over the lamp, when it boils, bubbles will arise, take fire, and detonate as they leave the water.

Con-tact, *s.* close union.

CHAP. VIII.

Of Carbon.

Q. What is Carbon?

A. Nothing more than charcoal in a state of purity, or unmixed with foreign ingredients.

Q. Is there much of this principle in nature?

A. Carbon forms a considerable part of the solid matter of all organized bodies, but is most abundant in vegetables; particularly wood.

Q. How is pure carbon to be obtained?

A. The purest that can be obtained by art, still contains some hydrogen; that which is in common use for culinary purposes, is always combined with other substances, hydrogen particularly.

Q. In what form does the purest carbon present itself?

A. The diamond has been found to be the purest specimen of carbon that has offered itself to the notice of chemists; the process of its chrystallization is totally unknown.

Cotton is likewise composed almost entirely of corbon.

Q. Is the diamond combustible?

A. Yes: and by burning it, its chemical nature has been ascertained; the product of this combustion, like all other carbon, has proved carbonic acid gas.

Q. What is carbonic acid gas?

A. It was formerly called fixed air. If I burn a piece of the purest charcoal in oxygen gas, it gradually combines with the oxygen, and gives out a gas, which is carbonic acid gas, as much in weight as the sum of the weight of the carbon and oxygen consumed.

Q. As carbonic acid contains so much oxygen, is it not wholesome to breathe?

A. Carbonic acid is not only unfit for respiration, but extremely pernicious if taken into the lungs. Hence arises the danger from the fumes of burning charcoal.

Q. Can this acid be condensed into a liquid?

A. No: it is a permament elastic fluid, but water may be strongly impregnated

with it. Seltzer water is of this nature, the sparkling is occasioned by the attempt of the gas to escape.

Q. Have you mentioned all the properties of carbon?

A. No: that would be impossible in so small a treatise, it is merely necessary to give a general idea of its nature.

CHAP. IX.

Of Metals.

Q. WHAT are metals?

A. They are bodies of a very different nature from those already examined, for they are some of the most brilliant, most *ponderous*, and most *palpable* substances in nature: they form a very important branch of practical chemistry.

Q. Are they generally found in their pure metallic state?

A. They are more or less oxygenated, or combined with sulphur, earths or acids; they are found in the bowels of the earth,

Pon-de-rous, *a.* heavy, of great weight.
Pal-pa-ble, *a.* the quality of being perceived by the touch.

spread in strata or beds, combined with other substances called ores.

Q. Have not metals a great affinity for oxygen?

A. Yes: but in different degrees. Some will combine with it only at a high temperature; others, as manganese, immediately absorb oxygen on being exposed to air, and crumble to an oxyd in a few hours.

Q. Do any other metals oxydate at the temperature of the atmosphere?

A. They all do, more or less, except gold, silver, and platina. Copper, lead, and iron, oxydate slowly in the air, and cover themselves with a sort of rust which is the oxyd of the metal.

Q. Are metals combustible?

A. Yes: except gold, silver, and platina, at a very high temperature; but with this exception, they will burn readily in oxygen gas, as has already been described.

Q. Is there no method of burning those three metals?

A. Yes: by means of the voltaic battery,

which is an apparatus lately invented for producing a peculiar kind of electricity.

Q. Can the oxyds of metals be restored to their metallic state?

A. Yes: by depriving them of their oxygen, which may be done by heating them red hot with charcoal, carbon having greater affinity for oxygen than the metals.

Q. Is there not a more speedy method of oxydating metals, than by simply exposing them to the atmosphere?

A. Yes: acids containing a much greater proportion of oxygen than either air or water, and yielding it easily to metals, produce oxyds of those metals very rapidly; from some nitric acid on a piece of copper leaf, an *effervescence* commences, the oxygen combines with the metal and produces an oxyd of copper, and the rest of the acid flies off in the form of a gas.

Q. Will not acids entirely dissolve metals?

A. Yes: and in this case they enter into a chemical combination with the acid and

---

Ef-fer-ves-cence, *s.* an intestine motion productive of heat.

for an entirely new compound, or a peculiar and important class of compound salts.

Q. Is there any acid that can dissolve the three perfect metals, gold, silver, and platina?

A. Only one: the oxygenated muriatic acid, which can dissolve gold, or any other metal, by burning it rapidly. Silver is dissolved by nitric acid.

Q. Are there any metals capable of being converted into acids?

A. There are five: arsenic, molybdena, chrome, tungsten, and columbium, that will combine with a sufficient quantity of oxygen to form acids.

Q. Will metals combine only with acids?

A. They are capable of uniting also with sulphur, phosphorus, carbon, and with each other; these combinations are called sulphurets, phosphorets, carburets, &c.

The phosphorets offer nothing remarkable.

The sulphurets form that peculiar kind of mineral called pyrites.

The only carburets of iron of any conse-

quence are steel and plumbago, or black lead.

Q. Is there any peculiarity in mercury?

A. That it is fusible at the common temperature of our atmosphere, while other metals require a considerable degree of heat to fuse them. Mercury becomes fixed or solid when the cold is 72° below the freezing point, which happens only in countries near the poles.

Q. What is verdigris?

A. It is a compound salt, formed by the union of vinegar and copper; it is of a beautiful green colour, and much used in painting, but poisonous; therefore copper vessels should never be used unless previously cleaned with great care.

Q. Does copper produce any other salt?

A. The solution of copper in nitric acid affords a salt, that produces a curious effect on tin; take some tinfoil, sprinkle some water and some of this salt on it, and wrap it up suddenly into a lump, a considerable vapor and sparks of fire will issue from it.

Q. Is there any other compound salt that deserves mentioning?

A. There is a beautiful green salt produced by the combination of cobalt with muriatic acid, which forms a sympathetic ink. Characters written with a solution of this are invisible when cold, but gently heated, assume a bluish green colour.

CHAP. X.

Of the Attraction of Composition.

Q. WHAT is the Attraction of Composition?

A. It is the attraction that subsists between bodies of different natures, which occasions them to combine and form a compound when they come in contact.

Q. Are there not some general laws of chemical attraction?

A. Yes; first it takes place only between bodies of a different nature, as between an acid and an alkali, oxygen and a metal.--- Second, that it takes place only between the most minute particles of bodies; therefore

the more minutely their bodies are divided, the more readily they act upon each other. Third, that it can take place in a considerable number of bodies. Fourth, that a change of temperature always takes place at the moment of combination. Fifth, that the properties which characterize bodies in their separate state, are altered or destroyed by their combination. Sixth, the force of chemical affinity between the constituents of a body, is estimated by that which is required for their separation. Seventh, bodies have, amongst themselves, different degrees of attraction.

CHAP. XI.

Of Alkalies.

Q. What are Alkalies?

A. They consist of metallic bases, combined with oxygen, have an *acrid* taste, a

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A-crid, *a.* tasting hot and bitter, and leaving a painful heat in the mouth.

pungent smell, and a *caustic* action on the skin and flesh. They likewise turn the blue infusions of vegetables, green.

Q. How many alkalies are there?

A. Three; potash, soda, and ammonia; the two former are called fixed alkalies, the latter volatile akali.

Q. In what proportions are the metals and oxygen combined in these alkalies?

A. In potash about 86 parts of potassium to 14 lbs. of oxygen; soda, 77 parts of sodium to 23 of oxygen; ammonia is of a more complicated nature.

Q. What are the properties of potash?

A. First, it combines readily with oil or fat, and forms that useful compound called soap. Second, melted with silicious earth or flint, it forms glass. Third, it is extremely useful in many other arts, and combined with nitric acid, forms saltpetre.

Q. What is soda?

A. It so nearly resembles potash in its general properties, as scarcely to be distinguished from it, exeept by the difference of the salts which they form with acids.

Pun′-gent, *a.* affecting the senses with a sharpness.
Caus′-tic, *a.* operating like fire, both with respect to the

Q. How is soda obtained?

A. Generally from the combustion of marine plants, by an operation similar to that by which potash is obtained from other vegetables.

Q. Will soda assist in the formation of glass and soap as potash does?

A. Yes, equally well, and in some cases it is preferred.

Q. What is ammonia or volatile alkali?

A. It is of the same nature as hartshorn. It is generally extracted from a compound salt, formerly brought from Ammonia, in Lybia, and from thence called sal ammoniac; but its scientific name is muriat of ammonia.

Q. When extracted from the salt, what kind of substance is ammonia?

A. Its natural form is that of gas; it is called ammonial gas.

Q. Of what does it consist?

A. Of oxygen, nitrogen, and hydrogen.

Q. What are its properties?

A. It forms soap, but not glass; it has so strong an attraction for water, that it cannot be collected in a receiver over water,

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heat it occasions, and the consumption it causes in the parts to which it is applied.

but over mercury only, as otherwise it would be totally absorbed. Hartshorn is water thus impregnated.

Q. What is sal volatile?

A. It is carbonat of ammonia dissolved in water. In its *concrete* state it is called salt of hartshorn.

Q. From whence is muriat of ammonia or sal ammoniac now obtained?

A. From any animal substance, such as wool, horn, bones, flesh, &c. by decomposition.

CHAP. XII.

Of Earths.

Q. What are Earths?

A. They are substances composed of a metallic basis, combined with oxygen; they are incombustible.

A. How many earths are there?

A. Ten: silex, alumine, barytes, lime, magnesia, strontites, yttria, glucina, zirconia, and jargonia. The last five being of late discovery, are but imperfectly known.

Con′-crete, *a.* formed by the union of several particles or substance.

Q. Do they enter into the composition of many substances?

A. Yes; from the most precious jewels (diamond excepted, which is carbon) to the commonest pebbles: in short, all the immense variety of mineral products may be referred to some of these earths, either in a simple state, or combined the one with the other, or blended with other ingredients.

Q. What are the peculiar properties of earths?

A. Insipidity, dryness, unalterableness in the fire, infusibility, &c. Barytes, magnesia, lime, and strontites, are called alkaline earths, because they possess all the properties of alkalies.

Q. What is silex?

A. Silex or silica abounds in flint, sand, sandstone, agate, jasper, &c. it forms the basis of many precious stones; strikes fire with steel; produces a variety of silicious crystals, of which rock crystal is the purest specimen.

Q. With what acid does silex combine?

A. With the fluoric only, which for that reason can never be kept in glass vessels, as having a strong affinity for silex, it detaches that substance from the potash, and thus destroys the glass.

Q. What is alumine?

A. It is chiefly found in clay; is, when pure, soft to the touch, makes a paste with water, and hardens in the fire. It is the most essential ingredient in pottery ware, from the coarsest to the most delicate porcelain. It has a strong tendency to combine with silex. The ruby, oriental sapphire, amethyst, &c. consist chiefly of alumine.

Q. What is barytes?

A. It is remarkable for its weight, and for its strong alkaline properties, such as destroying animal substances, turning blue vegetable colours green, and shewing a powerful attraction for acids.

Q. What is it use?

A. It is a very valuable chemical test, as from its great affinity for sulphuric acid, it will always detect it in any substance or combination whatever, by immediately uniting with it and forming a sulphat of barytes.

Q. What is lime?

A. Lime is a strong alkaline. It is not met with in its simple state in nature, but combined with water and carbonic, and it forms the common lime-stone. But these

substances are *volatilized* in the kiln by the heat. It is then called quick lime.

Q. What are its properties?

A. It is so caustic, that it is capable of decomposing the flesh of animals very rapidly, without their undergoing *putrefaction*. Water found on it is immediately absorbed, and gives out its latent heat to a very considerable degree.

Q. Is not chalk a species of lime?

A. It is carbonat of lime, or lime combined with carbonic acid.

Q. Has lime any further properties deserving notice?

A. It combines with most acids; unites with phosphorus and with sulphur. It is the bases of all calcareous earth and stones, and found both in the animal and vegetable creation.

Q. Is lime of much importance in the arts, &c.?

A. It is a most essential requisite in architecture, agriculture, dyeing, &c.

Q. What is magnesia?

A. It is a fine white powder, very light; has not so great an affinity for acids as lime;

Vo-la″-ti-liz-ed, *pt.* made to fly off in vapour.
Pu-tre-fac′-ti-on, *s.* the act of growing rotten.

it does not attract and *solidify* water as lime does, but when mixed with water, and exposed to the atmosphere, it slowly absorbs carbonic acid from it, and thus loses its causticity.

Q. Is it of any use in medicine or the arts?

A. Combined with sulphuric acid, it forms a powerful medicine called sulphat of magnesia or Epsom salts.

CHAP. XII.

On Acids.

Q. What is to be observed of acids?

A. They are compounded of particular bases combined with oxygen. If the portion of oxygen be very small, they are denominated merely oxyds. If a greater quantity of oxygen be combined, it is denoted by the term *ous*; if the greatest, by the termination *ic*. Thus sulphurous acid is the weaker; sulphuric acid the stronger of the two.

Q. How many acids are there?

A. There are at present reckoned 34, but as science improves, their number will increase by new discoveries.

So-li″-di-fy, *v.* to harden, to make solid.

Q. How are they classed?

A. First---Acids of known and simple bases:

Sulphuric,	Arsenical,	Fluoric,
Carbonic,	Tungstenic,	Muriatic.
Nitric,	Molybdenic,	
Phosphoric,	Boracic,	

Secondly---Acids of binary or double bases or radicals, of vegetable origin:

Acetic,	Malic,	Succinic,
Oxalic,	Gallic,	Camphoric,
Tartarous,	Mucous,	Suberic,
Citric,	Benzoic,	

Thirdly---Acids of triple bases, of animal origin:

Lactic,	Bombic,	Lithic.
Prussic,	Sebacic,	
Formic,	Zoonic,	

Q. Can the first class of acids be decomposed?

A. Yes; if I pour a little sulphuric acid on a piece of iron, it immediately imparts its oxygen to the iron, and produces an oxyd of iron or rust, consequently it is no longer an acid.

Q. What is sulphuric acid?

A. It is an acid obtained by volatilizing sulphat of iron with a strong heat; it is

then combined with water, and becomes what is vulgarly called oil of vitriol.

Q. What extraordinary effect is produced by sulphuric acid?

A. When mixed with water, it *evolves* a heat considerably above that of boiling water.

Q. Is sulphuric acid of use in the arts?

A. It is particularly useful in bleaching and in destroying vegetable stains, besides answering many other valuable purposes, too tedious to mention.

Q. Are there not certain neutral salts produced by the combination of this acid with alkalies, earths, and metals?

A. Yes; sulphat of potash, sulphat of soda, sulphat of lime, of magnesia, of alumine, of iron, &c. &c.

Q. What is phosphoric acid?

A. It is an acid obtained from phosphorus. The only salt of consequence derived from the acid is phosphat of lime, which is the basis of all bones.

Q. What is nitric acid?

A. It is a combination of oxygen and nitrogen, which, when absorbed by water, is vulgarly called aqua fortis.

E-volve, *v.* to unfold, to emit.

Q. How is nitric acid obtained?

A. Mix some nitrat of potash and sulphuric acid in a retort and heat it, the sulphuric acid having a greater affinity for potash than the nitric, will set the latter at liberty, which may be collected in a receiver.

Q. Will not the nitric acid dissolve metals?

A. Yes, except gold and platina; for this reason it is used by engravers to produce those impressions on copper-plates called etchings.

Q. How is this performe ?

A. The plate is first thinly covered with wax, on which the drawing is made with a needle quite through to the plate, nitric acid is then poured on, which corrodes the copper when the wax has been removed, and produces the etching.

Q. What salts may be produced from nitric acid?

A. Nitrat of potash, commonly called salt petre; nitrat of ammonia, from which may be obtained the gaseous oxyd of nitrogen, which, if inhaled by the lungs, produces an intoxicating effect; and nitrat of silver, or the luna caustic, much used by surgeons.

Q. What is carbonic acid?

A. An acid produced from the combustion

of carbon, either in its purest state, as in the diamond, or from common charcoal. Light a piece of charcoal, place it under a receiver, and when the charcoal is extinguished, the air will be found mixed with carbonic acid.

Q. How can we separate the carbonic acid from the air with which it is mixed?

A. Introduce under the receiver some caustic lime or caustic alkali, which will soon attract the whole of the carbonic acid to form a carbonat of lime or of soda.

Q. How can pure carbon be obtained from either of these carbonats?

A. By burning phosphorus in a close vessel with the carbonat, the phosphorus absorbs the oxygen whilst the carbon is separated in the form of a black powder.

Q. Is carbonic acid gas found in abundance?

A. It is supposed to form about one thousandth part of the atmosphere, and is constantly produced by the *respiration* of animals.

Q. Is it any where found unmixed with the atmosphere?

Re-spi-ra'-ti-on, *s.* the act of breathing.

A. In the Grotto del Cane, near Naples, this gas exists in its purity; but as it is heavier than atmospheric air, it does not rise above two or three feet from the ground. A man may therefore stand upright in this cave with safety; but to show the *deleterious* effect of this gas, they take a dog and hold him near the ground, he is soon deprived of all appearance of life, and it is only by instantly throwing the poor animal into the neighbouring lake, that he can be recoverd from this insensiblity.

Q. Can you mention any other process by which carbonic acid gas is produced?

A. From fermentation; great quantities of it continually arise from worts, when in a state of fermentation; it is generally called *fixed air.* If a lighted candle be immersed in it, it is instantly extinguished, and produces immediate death, if admitted into the lungs.

Q. Is this acid pernicious when admitted into the stomach?

A. It is generally considered the reverse, as it forms an ingredient in many mineral waters, which are denominated *acidulous*, or *gaseous mineral waters*. It likewise

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De-le-te′-ri-ous, *ad.* deadly, fatal, causing destruction.

gives that lively pungent taste to *fermented* liquors which is so much admired.

CHAP. XIII.

Acids continued.

Q. WHENCE is the boracic acid brought?

A. It is brought from Thibet, where it is found combined with soda; it is easily separated from the soda by sulphuric acid, and appears in the form of shining scales.

Q. How may this acid be decomposed?

A. Several ways; if we burn potassium in contact with it, *in vacuo*, the potassium attracts the oxygen from the acid, and leaves its basis in a separate state.

Q. How is the recomposition of this acid effected?

A. By burning some of its basis in oxygen gas, its light is extremely brilliant, and the result is boracic acid.

Q. What is the use of this acid?

A. Its principal use is in conjunction with soda, forming borat of soda, or as it is commonly called borax. It promotes the fusion of substances, removes the oxyd from

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Fer-ment′-ed, *v.* put into a state of intestine motion.
In va-cu-o, *s.* in an empty space.

the surface of metals, and is often employed in *assaying* metallic ores.

Q. What is fluoric acid?

A. This acid is obtained from a substance found frequently in mines called fluor or Derbyshire spar, which consists of lime and this acid.

Q. How is the acid obtained?

A. It is easily separated from the lime by the sulphuric acid, and unless condensed in water, ascends in the form of gas.

Q. Has this gas any peculiar property?

A. It has a great affinity for silex, so that if it be put in glass vessels, they are corroded and the silicious part of the glass unites with the gas.

Q. What purpose may be answered by this property?

A. Engraving may be performed with it on glass, in the same manner as etching on copper by the nitric acid.

Q. What is muriatic acid?

A. It is generally obtained from the common sea salt, from which it may be disengaged by the sulphuric acid. It is remarkable for its peculiar and very pungent smell and possesses in a powerful degree, most of

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As-say, *v.* to examine, to try.

the acid properties. It has a remarkable strong affinity for water, and appears as a whitish cloud whenever it meets with any moisture.

Q. What peculiar property has it besides?

A. If burnt with sulphur it detonates, or causes a report with astonishing violence.

Q. Is there any other denomination for this gas?

A. As it is susceptible of a high degree of oxygenation, it is then called oxymuriatic acid ?

Q. How is oxymuriatic acid to be obtained?

A. By distilling liquid muriatic acid over oxyd of manganese, which supplies it with the additional oxygen; it is but sparingly absorbed by water.

Q. Has this acid any peculiar property?

A. As muriatic acid extinguishes flame, this acid increases it, from the great quantity of oxygen combined with it. It is likewise of great service in destroying putrid effluvia and the infection of the small pox; through the vapor of nitric acid is generally preferred for this purpose, as it is less offensive.

CHAP. XV.

On Organized Bodies.,

ON THE NATURE AND COMPOSITION OF VEGETABLES.

Q. WHAT do you mean by organized bodies?

A. Organized bodies are such as are endowed by nature with various parts, peculiarly adapted to perform certain functions connected with life, by which unknown principle they are distinguished from other compounds formed merely by chemical attraction.

Q. What is the first class of organized bodies, and of what are the individuals composed?

A. Vegetables: all of which are ultimately composed of hydrogen, carbon, and oxygen; but they combine and separate these principles, by their various organs, in numberless ways, and form with them different kinds of juices and solids, which may be considered as their immediate materials.

Q. Enumerate some of them.

A. Sap,
Mucilage,
Saccharine matter,
Fecula,
Gluten,
Fixed oil,
Volatile oil,
Camphor,
Resins,
Gum Resins,
Balsams,
Cavulchoric,
Extractive colouring matter,
Tannin,
Woody fibre,
Vegetable acids, &c.

Q. Are all these materials found in an individual plant?

A. No: but they all have their origin in the vegetable kingdom;

Q. Are the combinations of these principles regulated by the laws of chemical attraction?

A. Yes: it is supposed that the organs of plants act mechanically, by bringing into contact such principles, and in such proportions, as will by their chemical combination, form the various vegetable products.

Q. What is sap?

A. It is the principal material of vegetables, since it contains the ingredients that nourish the plant. The basis of this juice is water, which holds in solution the various other ingredients which are gradually secreted by the different organs appropriated

for that purpose, as it passes through them in its circulation.

Q. What is mucilage?

A. It is a substance secreted from the sap, which sometimes exudes from trees in the form of gum.

Q. What is saccharine matter?

A. It is sugar; but it is never found in plants, being mixed with various ingredients; it abounds most in roots, fruits, and in a particular plant called the sugar cane. The maple tree likewise yields it in abundance.

Q. What is fecula?

A. It is the name given to that farinaceous substance resembling flour, found in all seeds, and in potatoes, parsnips, &c. It is intended by nature for the food of young vegetables, until it acquires sufficient strength to obtain by the root.

Q. What is gluten?

A. It resembles gum, but differs in being insoluble in water, whereas gum is easily dissolved.

Q. What is fixed oil?

A. Fixed oil is decomposed by heat; it is contained in the seeds of plants only, ex-

cept the olive,] from the *fruit* of which it is extracted.

Q. What is volatile or essential oil?

A. Oil that may be volatilized by heat; it is contained in every part of the plant except the seed; but is found most abundantly in the rinds of fruits.

Q. Is not the perfume of plants and flowers an essential oil?

A. Yes: and it is very plentiful in the leaves of mint, thyme, and all *odoriferous* herbs.

Q. What is camphor?

A. It nearly resembles volatile oil, but has some remarkable peculiarity; it is obtained chiefly from the camphor tree, a species of laurel growing in China, and the Indian isles; is extremely volatile and inflammable; *insoluble* in water, but soluble in oil.

Q. What are resins?

A. They are volatile oils peculiarly modified by oxygen; part of their hydrogen and carbon being disengaged by combustion. Pitch, tar, turpentine, copal, mastic, and frankincense are resins. Copal and mastic,

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O-do-ri′-fe-rous, *a.* fragrant, productive of a sweet scent.
In-so′-lu-ble, *a.* incapable of being dissolved by a fluid.

are used, dissolved in oil, or alcohal, as varnishes, being insoluble in water.

Q. What are gum resins?

A. Resins combined with mucilage. Myrrh and assafœtida are of this description.

Q. What are balsams?

A. Rezinous juices combined with a peculiar acid called the benzoic acid; such are the balsams of Tolu, Peru, &c.

Q. What is caoutchoric?

A. That substance known by the name of Indian rubber; it exudes from two or three species of trees in the East Indies, as a milky juice, into which moulds of clay are dipped, which form little bottles that blacken as they dry.

Q. What is extractive colouring matter?

A. That colouring matter which is extracted from vegetables for the purpose of painting and dyeing; their tints are not, in general, so durable as mineral colours.

Q. What is tannin?

A. It is an ingredient much used in the arts. It is obtained chiefly from the bark of trees, particularly of the oak; it is found also in nut galls, and in a few other vegetables.

Q. What is woody fibre?

A. It is the hardest part of plants, and forms a kind of skeleton, which retains its shape after the other materials have disappeared.

CHAP. XVI.

Of Vegetable Acids.

Q. How many vegetable acids are there?

A. Eleven.

The Mucous Acid, obtained from gum, or mucilage.

Suberic,	cork.
Camphoric,	camphor.
Benzoic,	balsam.
Gallic,	galls, bark, &c.
Mallic,	ripe fruits.
Citric,	lemon juice.
Oxalic,	sorrel.
Succinic,	amber.
Tartarous,	tartrit of potash.
Acetic,	vinegar.

Q. What are their general properties?

A. They are all decomposed by heat, soluble in water, and turn blue vegetable colour red.

Q. Is it necessary to describe these severally?

A. As their shades of difference are small, it may be necessary merely to mention that the oxalic acid distilled from sorrel, is the highest term of vegetable acidification; and that the gallic acid constitutes what is called the *astringent* principle in vegetables. It is generally combined with tannin.

Q. How may this astringent principle be detected in vegetable infusions?

A. By pouring in a little of the solution of sulphat of iron, which will produce a black precipitate resembling ink.

Q. Are the vegetable acids always found pure?

A. By no means: they are frequently found in the state of compound salts; but as the acid predominates, they are called acidulous salts. Such is cream of tartar.

CHAP. XVII.

Of the Decomposition of Vegetables.

Q. Are vegetables as easily decomposed as minerals?

As-trin′-gent, *a.* endued with the power of bracing or contracting the parts of a body.

A. Much easier: for their composition being more complicated, they more readily undergo chemical changes; for the greater the variety of attractions, the more easily the equilibrium is destroyed, and new combinations introduced.

Q. Does this decomposition take place during the life of the plant?

A. No: it does not take place until the plant has produced its fruit, or seed, and ceased to be useful; unless some accident should cause its premature death.

Q. Into what principles does the decomposition of vegetables resolve them?

A. Into their simple and primitive ingredients, hydrogen, carbon, and oxygen.

Q. Is this a quick process?

A. No, very long: during which a variety of new combinations is successively established and destroyed.

Q. Are any of these processes deserving attention?

A. Yes: in the highest degree. The decomposition of vegetables is always attended by a violent internal motion, produced by the disunion of one order of particles, and the combination of another. This is called fermentation.

Q. What ingredients are necessary to produce this decomposition?

A. Water and a degree of heat, for if vegetables be thoroughly dried, no decomposition will take place, nor when they are frozen.

Q. Are there not several successive fermentations in the decomposition of vegetables?

A. Yes: the first is the *saccharine fermentation*, to which degree barley is fermented previous to its being dried for malt. Seeds likewise undergo this fermentation previous to the appearance of the young plant.

The second is the *vinous fermentation*, because its product is wine; thus beer is the wine of malt.

The third is the *acetous fermentation*, which converts wine into vinegar, by the formation of the acetous acid.

The fourth and last is the *putrid fermentation*, which is the final operation of nature, and her last step towards reducing organized bodies to their simplest combinations.

CHAP. XVIII.

Of the Composition of Animals.

Q. Of what are animals composed?

A. Of four fundamental principles; oxygen, hydrogen, carbon, and nitrogen, which form the immediate materials of animals, gelatine, albumen, and fibrine.

Q. Are animals then less complicated in their nature than vegetables, as they are made up of fewer materials?

A. They form the most complicated order of compound beings; their organization is more perfect and intricate; but notwithstanding the wonderful variety observable in the texture of the animal organs, the original compounds may be reduced to the three heads before-mentioned.

Q. As animal substances are so complicated, can they be easily decomposed?

A. As the scale of attraction increases in proportion to the number of ingredients, they are extremely susceptible of decomposition.

Q. Is their analysis easy, and has it been brought to perfection?

A. No: it is both difficult and imperfect; for as animals cannot undergo chemical examination while living, and are liable to alteration immediately after death, it is probable, that when submitted to the chemist's investigation, they are more or less altered in their combinations and properties.

Q. What is gelatine?

A. It is the chief ingredient of skin and of all the membraneous parts of animals, and may be obtained under the forms of glue, size, isinglass, and transparent jelly.

Q. From what part of animals may gelatine be obtained?

A. From almost every part, but more plentifully from skin, bones, horns, &c. Isinglass is gelatine produced from a particular species of fish.

Q. What is albumen?

A. In its most simple state, albumen appears in the form of a transparent viscous fluid, without taste or smell; it coagulates with a moderate degree of heat, and can never be restored to its fluidity.

Q. Is albumen abundant in animal composition?

A. The substance that composes the nerves; the serum, or white part of the blood; the white of eggs, and the curds of milk, are little else than albumen variously modified.

Q. What is the reason the white of an egg tarnishes silver?

A. Because it contains a little sulphur which at the temperature of an egg just boiled, will decompose the drop of water that wets the spoon, and produces sulphurated hydrogen gas, which will tarnish silver.

Q. What is fibrine?

A. It is an insipid, inodorous substance, having something the appearance of fine white threads adhering together; it is the essential constituent of muscle, or flesh, in which it is mixed with and softened by gelatine.

Q. What other substances enter into the animal system?

A. Many which are not peculiar to it, as oils, acids, salts, &c. Animal oil is the chief constituent of fat; it abounds in cream, and is obtained in the form of butter.

CHAP. XIX.

Of Animal Acids.

Q. WHAT are animal acids?

A. Such as are peculiar to animals are few in number. Those that we find ready formed are:

The bombic acid, obtained from silk worms.
The formic .... ants.
The lactic, ...whey of milk.
The sebacic, ... oil, or fat.

Those produced during the decomposition of animal substances by heat, are the prussic and zoonic; the latter is produced by roasting meat.

Q. What is the prussic acid?

A. It is commonly obtained from blood, by strongly heating that substance with caustic potash; the alkali attracts the potash from the blood, and forms with it a prussiat of potash; from this the acid can be obtained pure, by means of other substances that separate it from the alkali.

Q. What is its use?

A. It has a strong affinity for metallic oxyds, and precipitates the solutions of iron

in acids of a blue colour; this is the Prussian blue, so much used in painting.

Q. Does not this colour sometimes become darker by exposure to the atmosphere?

A. Yes: unless prepared with red oxyd of iron. So that the painter having harmonized his colours with the greatest care, finds afterwards this harmony destroyed.

CHAP. XX.

On Animalization, Nutrition, and Respiration.

Q. WHAT is animalization?

A. It is the process by which the food is assimilated, or converted into animal matter.

Q. By what organ is this process performed?

A. Chiefly by the stomach, which is the organ of digestion and the principal regulator of the animal frame.

Q. What is digestion?

A. It is the first step towards nutrition; it is supposed that a fluid found in the

stomach called the *gastric juice*, which is an extremely powerful solvent, is the principal *menstruum* in this operation.

Q. Into what substance is the food converted by this process?

A. Into a uniform pulpy mass called *chyme*, which mingling with the bile and other juices, is changed into a substance resembling milk, called *chyle*; this being collected into one large vessel, is poured from thence into the heart.

Q. What substance does it then form?

A. It then begins to form blood; but this change is not perfected till it has passed through the lungs, and been modified by *respiration*.

Q. What is respiration?

A. It is called *breathing*, which consists of a mechanical and chemical process.

Q. What is the mechanical part?

A. The mechanism of breathing depends on the alternate expansion and contractions of the chest, by which the air is regularly admitted and expelled.

Q. What is the chemical process?

A. As the heart by a particular motion

Men′-stru-um, *s.* a liquor used to dissolve any thing, or to extract the virtues of any ingredient by boiling.

drives the blood through the arteries, from whence it returns through the veins; it undergoes considerable alterations during the circulation, some of its constituent parts being gradually separated from it for the nourishment of the body, &c. the bright red colour of the arterial blood, changes by degrees to pulp by the time it is brought back through the veins; it is then unfit for circulation, until purified of the hydrogen and carbon which it has required.

Q. How is this effected?

A. By respiration. When the veneous blood enters the heart, it is driven from thence into the lungs. Here coming in contact with the air we breathe, the superabundant hydrogen and carbon are absorbed by it, and the blood restored to its primitive purity.

Q. From whence proceed the hydrogen and carbon with which the blood is impregnated when it comes into the lungs?

A. It requires fresh supplies from the chyle that mixes with it.

Q. What is supposed to cause the redness of arterial blood?

A. The addition of oxygen to the blood in the lungs, which gradually entering into

combination with the hydrogen and carbon in circulation, produces the purple colour.

Q. How is Animal Heat produced?

A. The process that purifies the blood produces likewise that genial warmth, called animal heat; for the oxygen in the air we breathe, combining with the hydrogen and carbon, disengages this heat.

Q. Is heat produced in the lungs only?

A. No: the combination of the oxygen with the hydrogen and carbon, is only begun in the lungs, and continues gradually through the circulation: it is thus uniformly disposed over the whole body.

Q. Is there any other circumstance that may contribute to this salutary purpose?

A. The blood in its circulation, by degrees has its capacity for caloric diminished, and heat of course must be disengaged.

Q. How is it that heat is increased by exercise?

A. The circulation is quickened; respiration accelerated, and consequently a greater quantity of caloric evolved, which is carried off by increased prespiration.

CHAP. XXI.

Explanation of the Chemical Terms made use of in this Catechism.

CRYSTALLIZATION, is when a body passing from a fluid to a solid state, assumes a regular form.

Detonation, an explosion caused by the expansion of certain substances, when either a rapid combination or decomposition takes place.

Digestion, the slow action of a solvent upon any substance, often assisted by the heat of a sand-bath.

Distillation, the operation which by means of heat and moisture, separates volatile matters from those that are fixed, or matters more or less volatile from one another.

Effervescence, the escape of volatile matters from the mass of a fluid, which, in their passage through, cause a kind of ebullition.

Fixed, an epithet descriptive of such bodies as resist the action of heat, so as not to rise in vapour. It is opposed to volatile.

Fusion, the passing of a solid body to a fluid state by means of heat.

Oxidation, or *oxygenation*, the combination of any other body with oxygen.

Precipitation, the effect which takes place in solution, in consequence of elective attraction, when one matter is let fall to the bottom, in consequence of the fluid particles combining with another. The product is also called a precipitation.

Solution, the dispersion of the particles of a solid body in any fluid in so equal a manner, that the compound liquor shall be perfectly clear and transparent.

Sublimation, is to dry matters what distillation is to humid ones. It is the process by which the volatile are separated from the fixed parts of bodies, by the application of heat alone, without moisture.

Volatilization, the reducing into vapour such substances as are capable of assuming that form.

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